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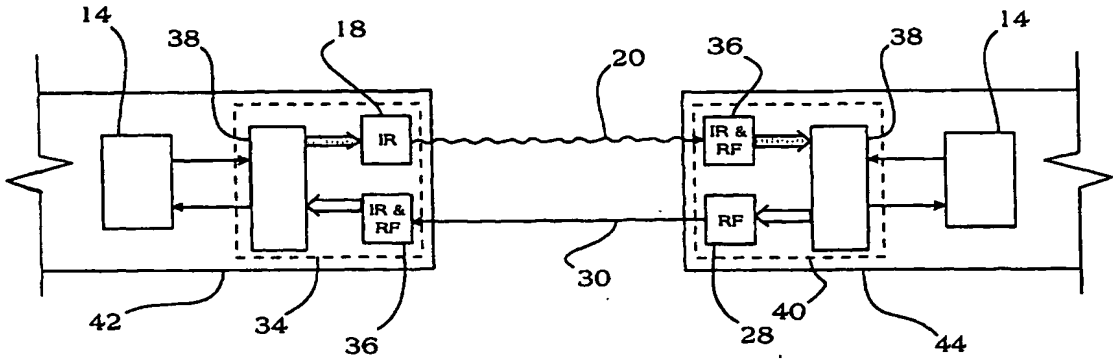

(57) Abstract

A device and system for integrating and processing Infrared (IR) and Radio Frequency (RF) signals is disclosed. The preferred system and device includes means for receiving both IR and RF signals. The device includes a dual mode signal conditioning means for processing received IR and RF signals. The device further is available in a variety of embodiments, including devices capable of transmitting IR signals only, devices capable of transmitting RF signals only, and "dual mode" devices capable of transmitting both IR and RF signals. The preferred device also includes transmit switch means for switching a transmit module between IR transmission and RF transmission modes. The preferred device further permits simultaneous transmission of IR and RF signals.

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DEVICE AND SYSTEM FOR INTEGRATING AND PROCESSING INFRARED (IR) AND RADIO FREQUENCY (RF) SIGNALS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to infrared (IR) and radio frequency (RF) communications systems and, more specifically, to a Device and System for Integrating and Processing Infrared (IR) and Radio Frequency (RF) Signals.

2. Description of Related Art

As technology becomes continually more accessible to the "common man," the ability to use, store, transfer and otherwise manipulate information has become the focus of most businesses as well as for the individual consumer. Access to the information resources is commonly by some sort of network system, including World Wide Web, "Intranets", local area networks, wide area networks, as well as corporate databases.

While the conventional method for connecting to one of these information networks has been via cable and wire, as the reliance upon connectivity to information has deepened, the desire to gain such access from mobile or portable devices has strengthened. These portable devices, such as Personal Digital Assistants, handheld computers, and even cellular telephones are now being connected to each other and to networks via Infrared Data Communications or via Radio Frequency Data Communications, depending upon the particular appliance. For example, a user may use a magnetic or "smart" card to activate a payphone and enable it to receive Ir or RF transmissions from their digital camera – the stored data could then be transmitted to a photo processing service for production. These wireless technologies have become so promising that it is virtually impossible to purchase a notebook computer today that does not include some wireless communications assembly resident within it.

The key problem with these wireless communications systems is one of cross-type incompatibility - once a device is built and configured to communicate via IR signals, it cannot communicate with RF signaling appliances, and vice versa. Each transmission type has its unique strengths and weaknesses, as well as proponents and detractors. This schism between the transmission types has and continues to create unrest and uncertainty in the electronic appliance market – no clear leader has evolved, but the constant battling serves to weaken the development of both technologies significantly.

What would be extremely helpful would be a device and system that is selectively capable of enabling communications with both IR-based and RF-based appliances, without significantly increasing the cost of the appliances. A cross-type appliance such as this would be able to use both communications types to their full extent, in applications where each is best suited.

SUMMARY OF THE INVENTION

In light of the aforementioned problems associated with the prior devices and systems, it is an object of the present invention to provide a Device and System for Integrating and Processing Infrared (IR) and Radio Frequency (RF) Signals. The preferred system and device should include means for receiving both Ir and RF signals. It is another object that the device include a dual mode signal conditioning means for processing received Ir and RF signals. It is a further object that the device be available in a variety of embodiments, including devices capable of transmitting Ir signals only, devices capable of transmitting RF signals only, and "dual mode" devices capable of transmitting both Ir and RF signals. The preferred device should include transmit switch means for switching a transmit module between Ir transmission and RF transmission modes. It is yet another object that the preferred device permit simultaneous transmission of Ir and RF signals.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention, which are believed to be novel, are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages, may best be understood by reference to the following description, taken in connection with the accompanying drawings, of which:

Figures 1A and 1B are functional schematics of electronic appliances incorporating prior IR and RF communication systems;

Figure 2 is a functional schematic of a preferred embodiment of the Dual Mode Receive/Infrared Transmit Transceiver of the present invention;

Figure 3 is a functional schematic of a preferred embodiment of the Dual Mode Receive/Radio Frequency Transmit Transceiver of the present invention;

Figure 4 is a functional schematic depicting the ability of an Infrared-transmitting appliance to communicate with a Radio frequency-transmitting appliance where both are equipped with the Dual Mode Receiver of the present invention; and

Figure 5 is a functional schematic of a preferred embodiment of an appliance equipped with the Dual Mode Receive/Dual Mode Transmit Transceiver of the present invention.

DETAILED DESCRIPTION

OF THE PREFERRED EMBODIMENTS

The following description is provided to enable any person skilled in the art to make and use the invention and sets forth the best modes contemplated by the inventor of carrying out his invention. Various modifications, however, will remain readily apparent to those skilled in the art, since the generic principles of the present invention have been defined herein specifically to provide a Device and System for Integrating and Processing Infrared (IR) and Radio Frequency (RF) Signals.

The present invention can best be understood by initial consideration of Figures 1A and 1B. Figures 1A and 1B are functional schematics of electronic appliances 10 and 12 incorporating prior IR and RF communication systems. In its typical form, the appliance with IR communications 10 comprises a communications controller 14 that is in communication with an IR transceiver 16. It should be appreciated that the communications controller 14 may be a stand-alone circuit, or it may be integrated into the Central Processing Unit of the appliance 10, depending upon the configuration of the particular appliance 10.

The typical IR transceiver 16 comprises an IR transmitter 18 for transmitting IR signals 20 to another appliance or device, and an IR receiver 22 for receiving IR signals 20 emanating from another appliance or device. The signals entering the IR transmitter 18 and leaving the IR receiver 22 are conditioned and processed for or from the communications controller 14 by a signal processor 24.

Similarly, the typical RF transceiver 26 comprises an RR transmitter 28 for transmitting RF signals 30 to another appliance or device, and an RF receiver 32 for receiving RF signals 30 emanating from another appliance or device. The signals entering the RF transmitter 28 and leaving the RF receiver 32 are conditioned and processed for or from the communications controller 14 by a signal processor 24.

It should pointed out that the conventional optical photodiodes used for IR receivers 22 utilize the same core high frequency bipolar silicon (HF-Si) or silicon-germanium (SiGe) technologies that are utilized in the manufacture of RF receivers 32.

Now turning to Figure 2, we can begin to explain the value of the present invention. Figure 2 is a functional schematic of a preferred embodiment of the Dual Mode Receive/Infrared Transmit ("DMR-IRX") Transceiver 34 of the present invention. The DMR-IRX transceiver 34 comprises an IR transmitter 18 (of the conventional design) for transmitting IR signals 20 to external devices. The unique aspect of this apparatus is inclusion of the Dual Mode Receiver ("DMR") 36, which is a unit configured to detect and receive both incident IR signals 20 and incident RF signals 30. Since the manufacturing technology for the conventional single-mode receivers is similar, the DMR 36 may be crafted from a single semiconductor substrate using HF-Si or SiGe technology. As such, the DMR 36 circuit could be designed to contain a mixed signal analog/digital receiver-demodulator capable of receiving and conditioning a received RF signal 30. At the same time, either substrate technology can function as an IR photodiode receiver (see above). Consequently, the DMR 36 can process the detected RF or IR signals 30 and 20 in a common receive circuit, or it can send the raw signal to a separate Dual Mode Signal Processor/Conditioner ("DMSP") 38.

The DMSP 38 could be further configured to provide separate outputs for the received IR and RF signals, respectively, or there could be one single output (as shown in this depiction). In any case, it should be appreciated that the DMR 34, as a single circuit replacement for the conventional single-mode IR and RF signal receivers, provides increased appliance functionality, reduced power consumption, optimization of circuit real estate, and an overall lower cost. Finally, it must be understood that the single IR transmitter 18 and single DMR 36 presented here is only one example; it might be desirable to include a plurality of transmitters 18 and/or DMRs 36 to provide increased functionality.

Figure 3 depicts a device that is closely related to the DMR-IRX transceiver 34 of Figure 2. Figure 3 is a functional schematic of a preferred embodiment of the Dual Mode Receive/Radio Frequency Transmit ("DMR-RFX") Transceiver 40 of the present invention. Essentially, the DMR-RFX transceiver 40 is a DMR-IRX transceiver 34 that has one or more RF transmitters 28 for transmitting RF signals 30 instead of the IR transmitter(s) of the DMR-IRX transceiver 34. Figure 4 describes the incredible versatility provided by the DMR-RFX and DMR-IRX transceivers 40 and 34.

Figure 4 is a functional schematic depicting the ability of an Infrared-transmitting appliance to communicate with a Radio frequency-transmitting appliance where both are equipped with the DMR 36 of the present invention. The DMR-IRX appliance 42 is a portable computer, telephone, personal digital assistant or other electronic device that includes a DMR-IRX transceiver 34 as described above in connection with Figure 2. As such, the DMR-IRX appliance 42 is capable of transmitting IR signals 20, while able to receive both IR signals 20 and RF signals 30. The DMR-RFX

appliance 44 is an electronic device of the type described above that includes a DMR-RFX transceiver 40 as described above in connection with Figure 3. The DMR-RFX appliance 44, therefore, can transmit RF signals 30 and receive both IR signals 20 and RF signals 30.

As can be seen, the DMR-IRX appliance 42, by transmitting IR signals 20 is fully capable of communicating with the DMR-RFX appliance 44, which is limited to transmitting only RF signals 30. This capability provides astounding functionality that was previously unavailable. Prior IR signal-transmitting devices could not communicate at all with RF signal-transmitting devices; the manufacturer and user were forced to choose (possibly at great limitation) between one signal technology and the other. Now, with the present invention, a simple upgrade to the receiver capability (i.e. exchange with a DMR 36) permits the single-mode transmitter device to communicate with a similarly-configured device transmitting the other type of signal!

Figure 5 provides yet another embodiment of the present invention. Figure 5 is a functional schematic of a preferred embodiment of an appliance 46 equipped with the Dual Mode Receive/Dual Mode Transmit ("DMR-DMX") Transceiver 48 of the present invention. As can be seen, the DMR-DMX appliance 46 includes a DMR-DMX transceiver 48; this unique transceiver 48 comprises that DMR 36 for receiving both IR and RF signals 20 and 30, as discussed previously. Furthermore, the DMR-DMX transceiver 48 includes a Dual Mode Transmit Module 50. The Dual Mode Transmit Module 50 is, essentially, at least one each IR transmitter 18 and RF transmitter 28, respectively. The two transmitters 18 and 28 are preferably coupled to an IR/RF transmit switch 52. The IR/RF transmit switch 52 allows the outgoing signal coming from the

Dual Mode Signal Conditioner 54 to be routed to either the IR transmitter 18 or the RF transmitter 28, or to both simultaneously. In operation, therefore, the DMR-DMX appliance 46 can selectively communicate with IR-based, RF-based or dual-mode external appliances. This flexibility permits the appliance 46 to be adaptable to any and all IR and RF networks and systems, and in particular, it permits the appliance to capitalize on the strengths of each signal transmission technology, as appropriate.

Those skilled in the art will appreciate that various adaptations and modifications of the just-described preferred embodiment can be configured without departing from the scope and spirit of the invention. Therefore, it is to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

CLAIMS

What Is Claimed Is:

1. A signal transceiver device, comprising a dual mode receiver, said receiver comprising:

infrared receiving means for receiving infrared signals incident thereon; and

radio frequency receiving means for receiving radio frequency signals incident thereon.

2. The device of Claim 1, further comprising infrared transmitting means for transmitting infrared signals.

3. The device of Claim 1, further comprising radio frequency transmitting means for transmitting radio frequency signals.

4. The device of Claim 1, further comprising a dual mode transmitting module for transmitting infrared and radio frequency signals.

5. The device of Claim 4, wherein said dual mode transmitting module further comprises transmit switch means for switching said module between transmitting said signals as infrared signals and transmitting said signals as radio frequency signals.

6. The device of Claim 5, wherein said transmit switch means permits simultaneous transmission of infrared and radio frequency signals.

7. The device of Claim 2, further comprising dual mode signal conditioning means for processing said received infrared and radio frequency signals.

8. The device of Claim 3, further comprising dual mode signal conditioning means for processing said received infrared and radio frequency signals.

9. The device of Claim 4, further comprising dual mode signal conditioning means for processing said received infrared and radio frequency signals.

10. The device of Claim 5, further comprising dual mode signal conditioning means for processing said received infrared and radio frequency signals.

11. The device of Claim 1, wherein said infrared receiving means and said radio frequency receiving means are constructed on a single semiconductor substrate.

12. The device of Claim 11, wherein said infrared receiving means and said radio frequency receiving means comprise a single electronic circuit.

13. An improved communication system, comprising:

a first appliance comprising infrared transmitting means for transmitting infrared signals and dual mode receiving means for receiving infrared and radio frequency signals; and

whereby said first appliance may communicate with a second appliance, said second appliance configured to transmit either infrared signals or radio frequency signals, or both said infrared and radio frequency signals.

14. The system of Claim 13, wherein said second appliance comprises infrared transmitting means for transmitting infrared signals and receiving means for receiving infrared signals.

15. The system of Claim 14, wherein said second appliance receiving means further comprises means for receiving radio frequency signals.

16. The system of Claim 13, wherein said second appliance comprises radio frequency transmitting means for transmitting radio frequency signals and receiving means for receiving infrared signals.

17. The system of Claim 16, wherein said second appliance receiving means further comprises means for receiving radio frequency signals.

18. The system of Claim 13, wherein:

said first appliance further comprises radio frequency transmitting means for transmitting radio frequency signals; and

said second appliance further comprises means for transmitting infrared signals.

19. The system of Claim 18, further comprising transmit switch means for alternatingly switching signal output between said infrared transmitting means and said radio frequency transmitting means.

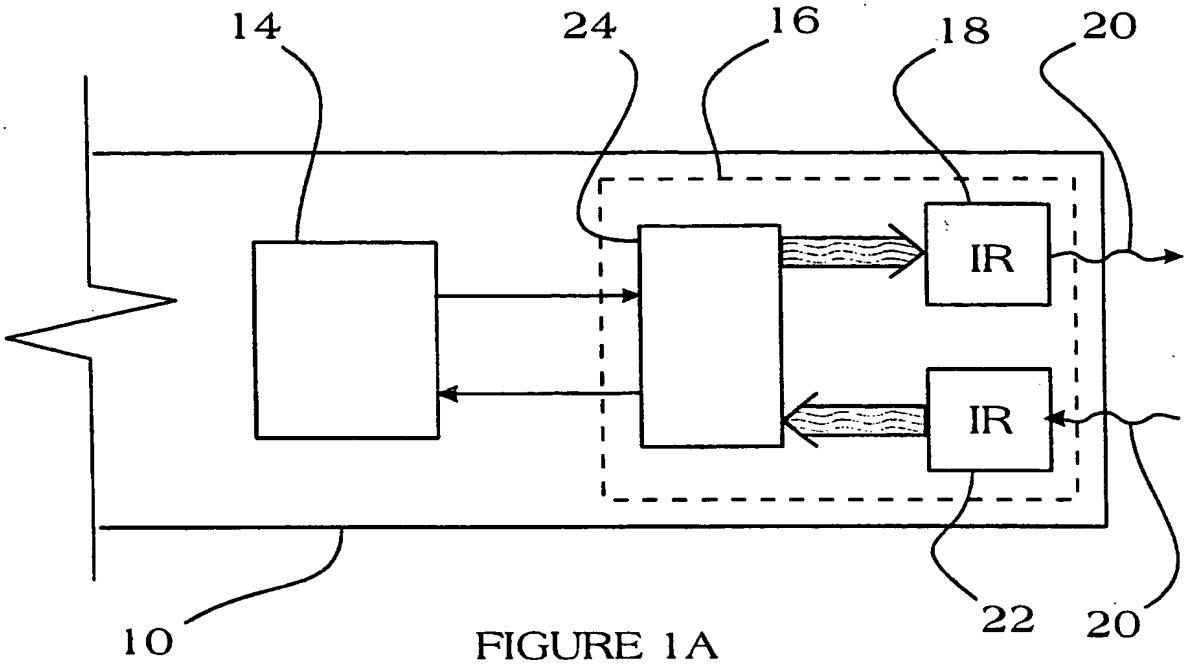

FIGURE 1A
PRIOR ART

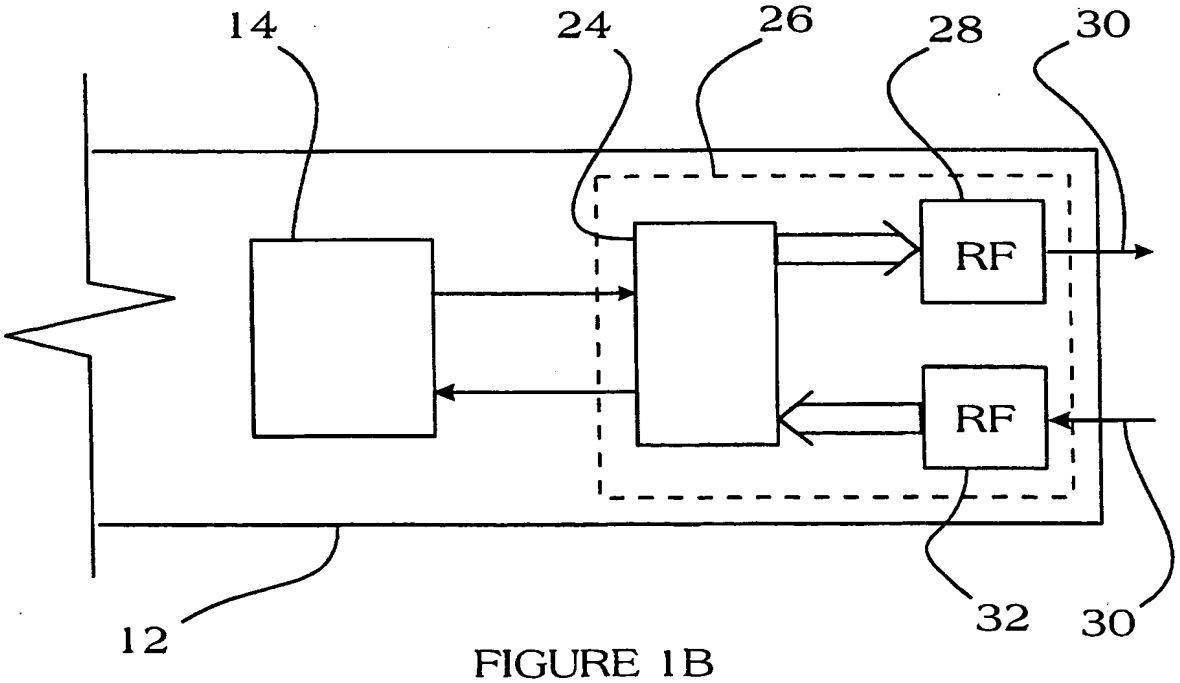

FIGURE 1B
PRIOR ART

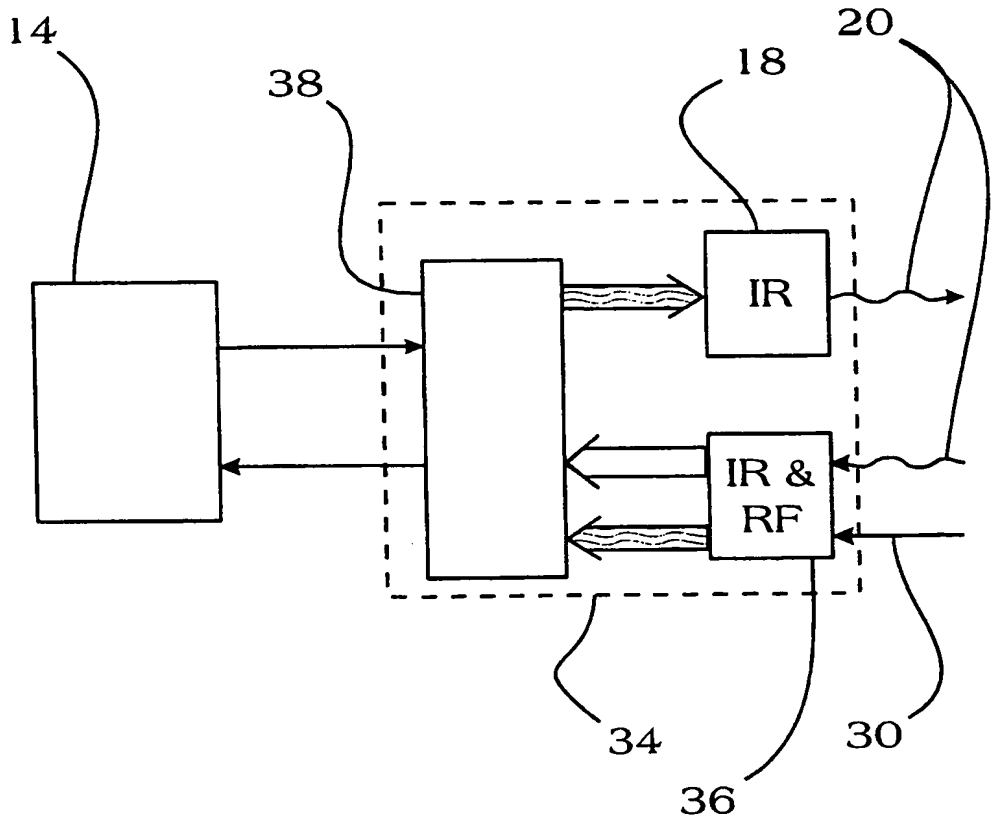

FIGURE 2

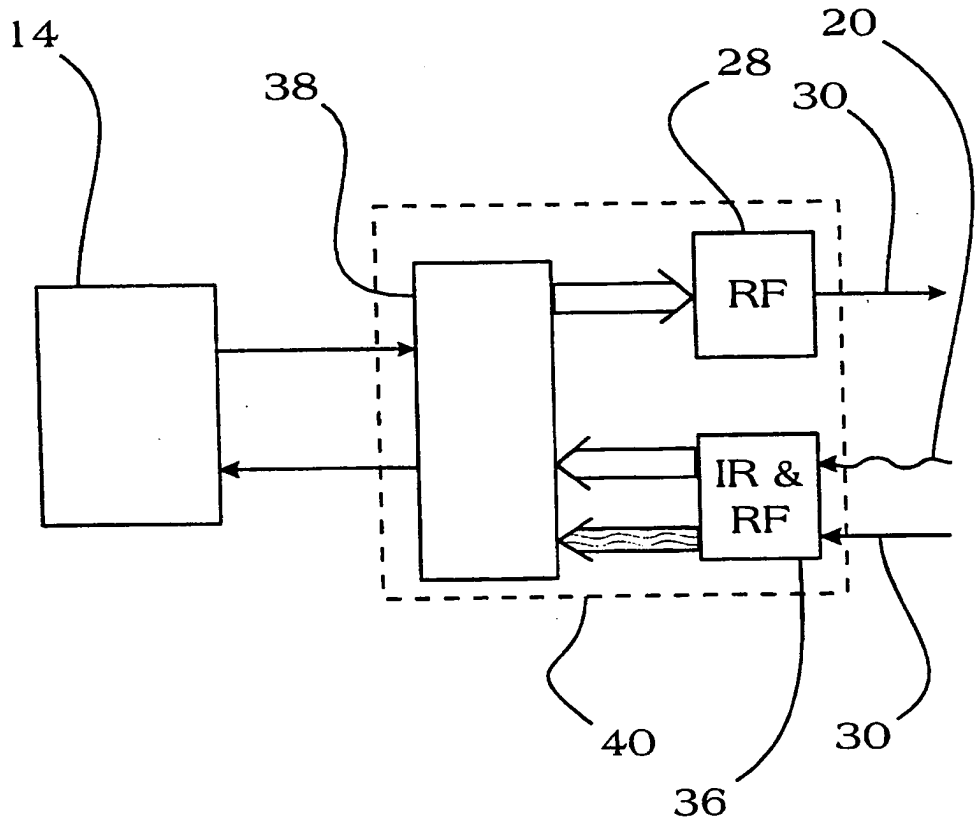

FIGURE 3

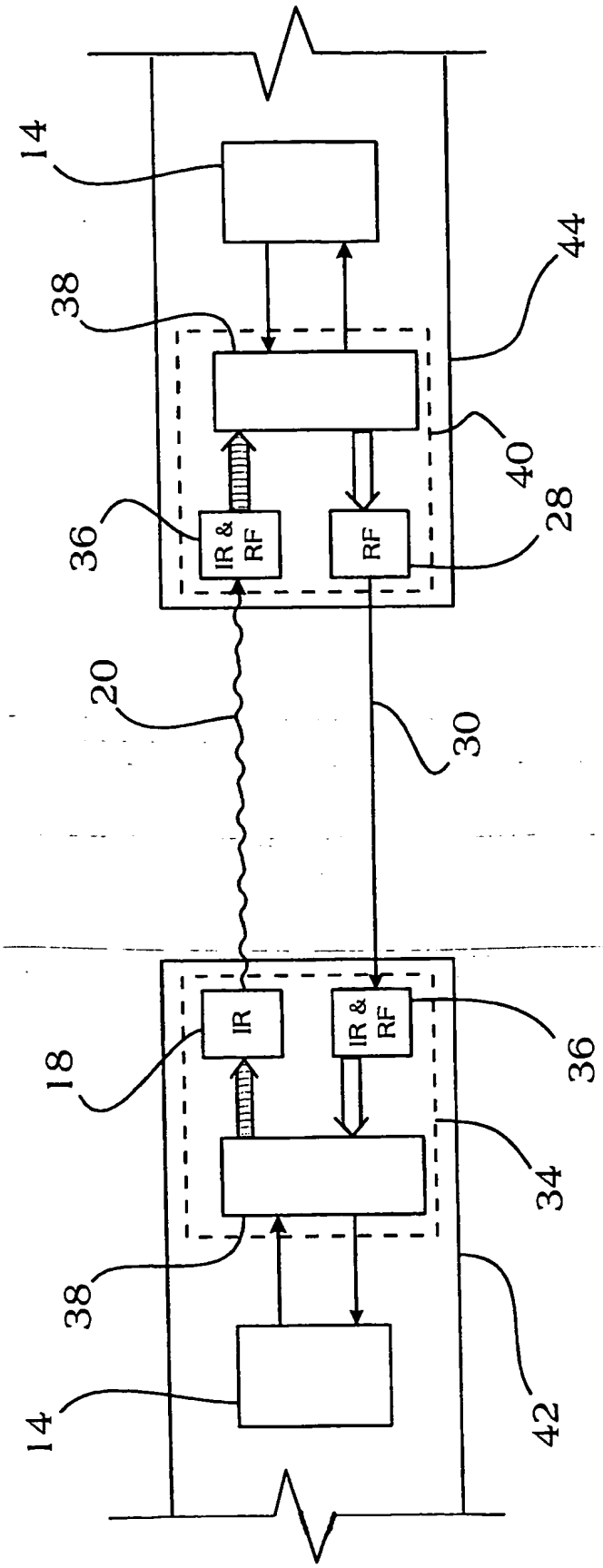

FIGURE 4

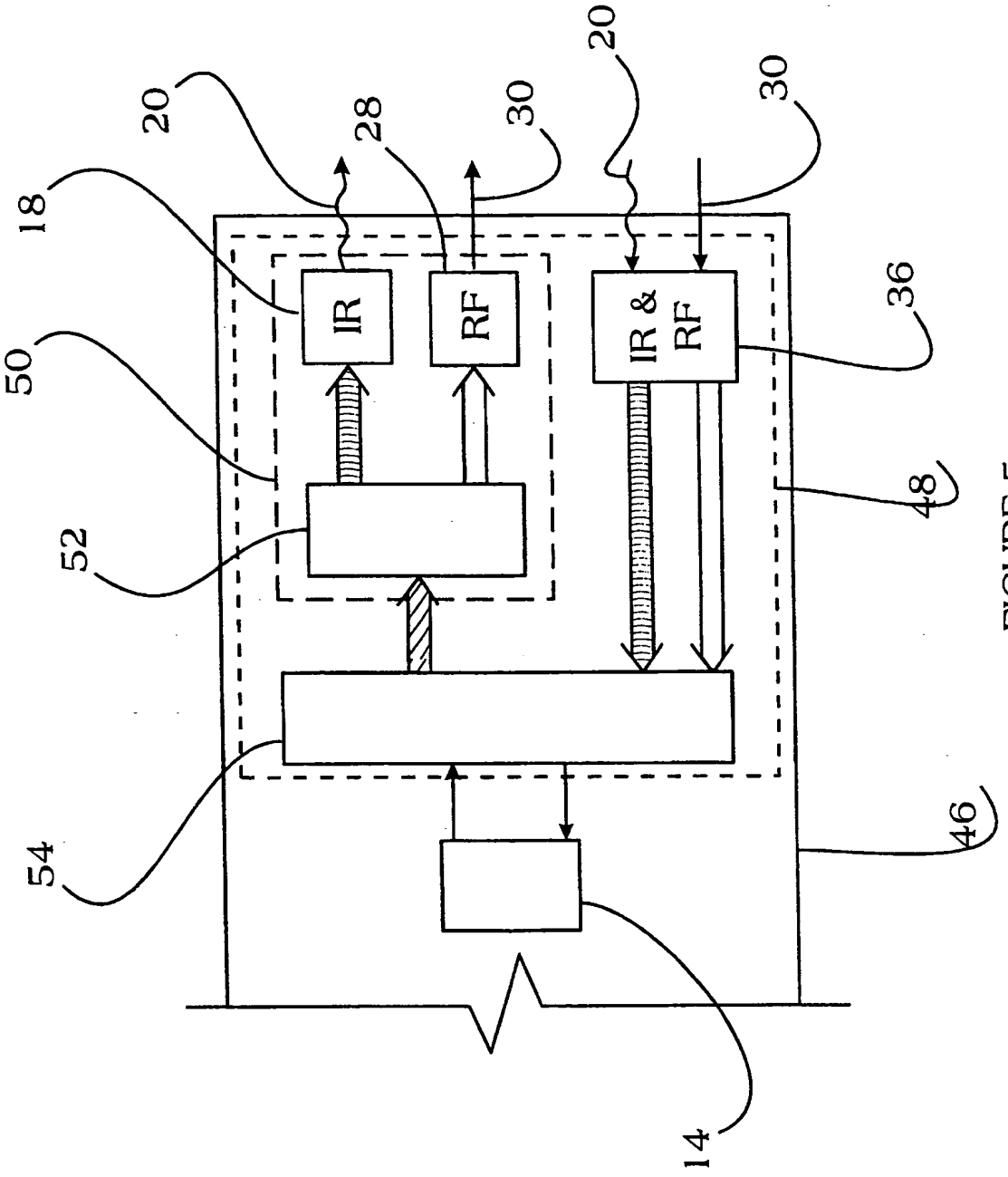

FIGURE 5

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 99/17639

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B10/10 H04B1/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 585 953 A (ZAVREL ROBERT J) 17 December 1996 (1996-12-17) abstract column 1, line 21 -column 2, line 36 figures 1,3	1-19
X	DE 44 33 896 C (SIEMENS AG) 9 November 1995 (1995-11-09)	1-4
A	abstract column 1, line 62 -column 2, line 15; figure 1	5-19
A	US 4 904 993 A (SATO KAZUO) 27 February 1990 (1990-02-27) abstract column 2, line 20 -column 4, line 5 figure 1	7-10, 13-19

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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